REMARKS

Favorable reconsideration of this application in view of the remarks to follow is respectfully requested. Since the present Response raises no new issues, and in any event, places the application in better condition for consideration on appeal, entry thereof is respectfully requested under the provisions of 37 C.F.R. §1.116.

In the Final Action, Claims 1 and 2 stand rejected under 35 U.S.C. §102(b) as allegedly anticipated by U.S. Patent No. 5,587,599 to Mahnkopf, et al. ("Mahnkopf, et al."). Claim 5 stands rejected under 35 U.S.C. §103(a) as allegedly obvious over Mahnkopf, et al. in view of U.S. Patent No. 5,506,427 to Imai ("Imai").

Turning to the anticipation rejection of Claims 1 and 2, it is axiomatic that anticipation under §102 requires the prior art reference to disclose every element to which it is applied. *In re King,* 801 F.2d 1324, 1326, 231 USPQ 36, 138 (Fed Cir, 1986). Thus, there must be no differences between the subject matter of the claim and the disclosure of the prior art reference. Stated another way, the reference must contain within its four corners adequate direction to practice the invention as claimed. The corollary of the rule is equally applicable: absence from the applied reference of any claimed element negates anticipation. *Kloster Speedsteel AB v. Crucible Inc.*, 793 F.2d 1565, 1571, 230 USPQ 81, 84 (Fed. Cir. 1986).

Applicant submits that the claims of the present application are not anticipated by the disclosure of Mahnkopf, et al., since the applied reference does not disclose applicant's claimed structure. More specifically, Mahnkopf, et al. do not disclose a bipolar transistor including a first single crystal semiconductor layer positioned over an insulating layer having a lightly doped region of a first type and at least one contiguous

heavily doped region of the first type, said lightly doped region and said contiguous heavily doped region functioning as a collector, *wherein the lightly doped region is directly underneath a base and is depleted of mobile charge carriers through the first semiconductor layer to the insulating layer*, as recited in Claim 1.

Applicant's claimed structure, as depicted in Fig. 6, includes a substrate 28, an insulating layer 26 over the substrate 28, a first single crystal semiconductor layer 18, 20, 22 positioned over the insulating layer 26 having *a lightly doped region 18 of a first type and at least one contiguous heavily doped region 20, 22 of the first type, the lightly doped region 18 and the at least one contiguous heavily doped region 20, 22 functioning as a collector, wherein said lightly doped region 18 is directly underneath a base 14*, a second patterned semiconductor layer 14 of a second type formed over said lightly doped region 18 of said first semiconductor layer to function as the base 14, and a third patterned semiconductor layer 12 of said first type position over the second semiconductor layer 14 to function as an-emitter 12, *the lightly doped region 18 of said first type having a dopant concentration to fully deplete of mobile charge carriers through the first semiconductor layer 22, 20, 18 to the insulating layer 26.* Applicant submits that the fully depleted region 18 of the collector is directly below the base 14 of the bipolar transistor, therefore providing a fully-depleted-collector SOI vertical bipolar transistor which has a much smaller base-collector junction capacitance than conventional devices and does not require a heavily doped subcollector layer.

Mahnkopf, et al. do not anticipate applicant's claimed structure because the applied reference fails to disclose a bipolar transistor having a collector region comprising a *lightly doped region 18 directly underneath a base 14*, where the lightly

doped region 18 fully depletes of mobile charge carriers to the insulating layer, as recited in Claim 1. Mahnkopf, et al., referring to FIG. 5, disclose a bipolar transistor having a collector region where the lightest degree of doping produces a depleted region (n^-) 9 in a lateral direction from the base (p) 21 of the device. In the prior art transistor, the collector region (n) 9, which is directly underneath the intrinsic base region (p) 21, is not fully depleted. Collector region 22 is quasi-neutral (n), being more heavily doped than the lightly doped region (n^-) 9 that is laterally spaced from the base region (p) 21 of the device. The quasi-neutral region (n) 22 underlying the base region (p) 21 results in a high series resistance collector. Therefore, since Mahnkopf, et al. fail to teach a *lightly doped region directly underneath a base, where the lightly doped region fully depletes of mobile charge carriers*; Mahnkopf, et al. fail to teach each and every aspect of the applicant's claimed invention.

Applicant further notes that the Mahnkopf, et al. transistor is far removed from the claimed structure, because the transistor disclosed in Mahnkopf, et al. functions similar to the prior art transistor described in FIG. 5 of applicant's specification. In the prior art transistor, depicted in FIG. 5 of applicant's specification, the electrons flow from the emitter region 3 through the base 4 into the collector 5. The collector 5 includes the quasi-neutral region (n) 22 having a very high resistance due in part to its relatively light doping concentration and relatively small thickness compared to the n+ type subcollector layer 7. The resulting collector series resistance is unacceptably large. The prior art transistor is depicted as follows:

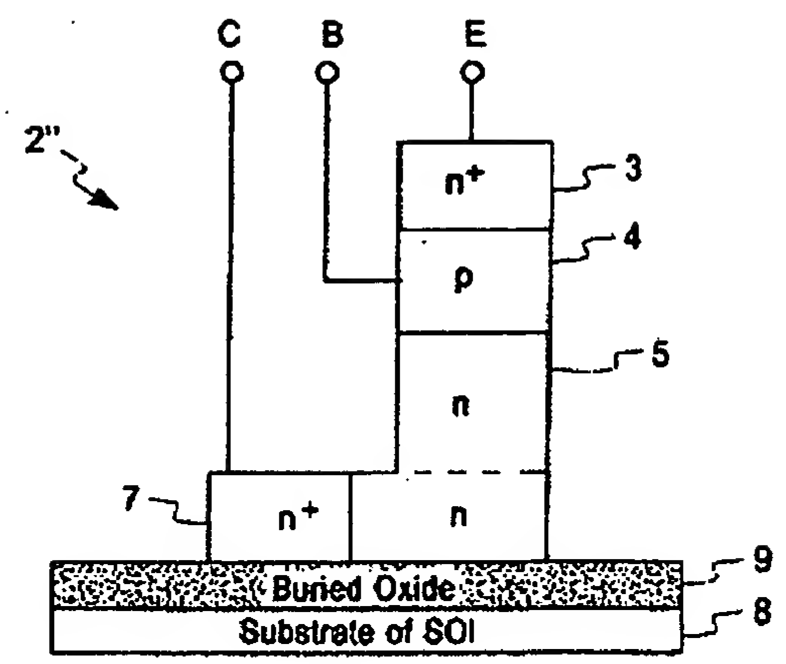
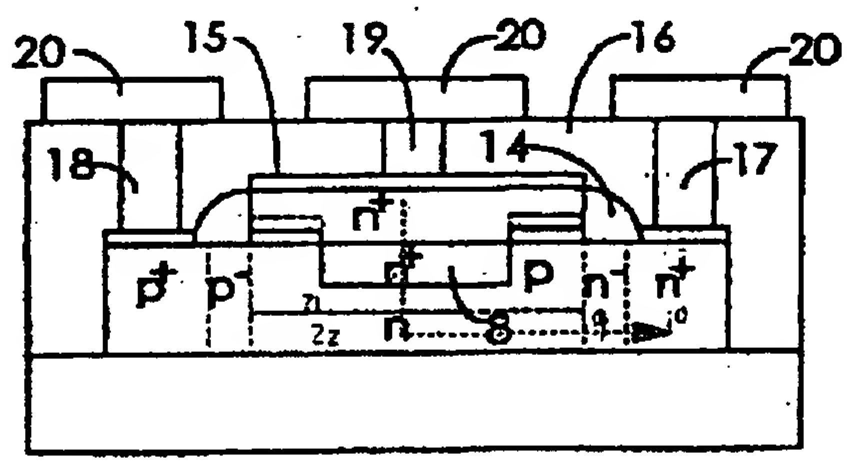


Fig. 5

The n-region 5 of the prior art transistor is equivalent to region (n) of the transistor depicted in FIG. 4 of Mahnkopf, et al.; both regions 5, (n) being quasi-neutral non-depleted regions having a high resistance. The transistor depicted by Mahnkopf, et al. is depicted as follows:



When the prior art transistor of Mahnkopf, et al. is turned on, electrons from the emitter region 8 flow vertically down across the intrinsic base layer (p) 21 and are collected by the quasi-neutral region (n) 22. This electron current is then carried from the quasi-neutral region (n) 22 through a laterally spaced lightly doped region (n^-) 9 to the collector contact region (n^+) 10. The series resistance of the quasi-neutral region (n) 22 is very high, making the transistor not suitable for most circuit applications.

Applicant has discovered that the high series resistance of the prior art devices, such as Mahnkopf, et al., is overcome by removing the quasi-neutral layer directly underlying the base region of the device with a fully depleted region. Applicant's produce a base depletion region extending vertically through the entire n-type collector layer to the underlying insulator; therefore producing a low resistance collector region.

It is the Examiner's position that since Mankopf, et al. disclose a doping concentration in a portion of the collector underlying the base 21 that is within the range of the doping concentration of applicant's collector, Mankopf, et al. disclose a collector region that is capable of fully vertically depleting to the buried insulating layer. Applicant respectfully disagrees and submits that the region of the collector directly underlying the base region in Mankopf, et al., despite having a doping concentration that is within the doping concentration disclosed by the applicant, is not the most lightly doped region of the collector and therefore will not fully deplete of charge carriers. Mankopf, et al. disclose a more lightly doped region (n) 9 that is laterally spaced from the portion of the collector that directly underlies the base.

When voltage is applied to a PN junction of the base and collector, depletion of charge carriers occurs first in the region of the collector having the lowest mobile charge carrier concentration. The region in which the charge carriers are depleted is also referred to as a space-charge zone. When a voltage is applied to the structure disclosed in Mankopf, et al., the lightly doped region (n^-) 9 depletes to provide a lateral collector space-charged zone (depletion region), where the more heavily doped region of the collector (n) 22 underlying the base (p) 21 is not depleted. See FIG. 5 and the abstract of Mahnkopf, et al.

Applicant's collector comprises a *lightly doped region 18 and at least one contiguous heavily doped region collector 20, wherein the lightly doped region 18 is directly underneath a base 14 and is fully depleted of charge carriers through the semiconductor layer to the buried insulator.* Applying a voltage to applicant's structure fully depletes the region of the collector directly underlying the base, since the lightly doped region 18 has a lower dopant concentration than the contiguous heavily doped region 20 of the collector. In contrast to the laterally depleted collector disclosed in Mankopf, et al., the claimed device disclosed by the applicant is vertically *depleted through the first semiconductor layer, in which the collector is formed, to the underlying insulating layer.* See Claim 1.

Mankopf, et al., despite disclosing a region of the collector underlying the base having a dopant concentration that is the within the range disclosed by the applicant, fail to disclose where a *lightly doped region directly underneath a base fully depletes of mobile charge carriers to said insulating layer*, since the region of the collector underlying the base in Mankopf, et al. does not have the lowest doping concentration of the collector. Therefore, Mankopf, et al. fail to disclose a lightly doped region of a collector that is directly below a base region that fully depletes of charge carriers through the semiconductor layer to the buried insulating layer, as recited in Claim 1.

The forgoing remarks clearly demonstrate that the applied reference does not teach each and every aspect of the claimed invention as required by King and Kloster Speedsteel; et al., therefore, the claims of the present application are not anticipated by Mahnkopf, et al. Applicant respectfully submits that the instant §102 rejection has been obviated and withdrawal thereof is respectfully requested.

Now turning to the rejection under 35 U.S.C. §103(a), it is the Examiner's position that Claim 5 is obvious over Mahnkopf, et al. in view of Imai. "To establish a prima facie case of obviousness of a claimed invention all the claimed limitations must be taught or suggested by the prior art". *In re Wilson*, 424 F.2d 1382, 1385, 165 USPQ 44, 496 (CCPA 1970).

The primary reference, Mahnkopf, et al., is defective as a reference, under 35 U.S.C. §103(a), for the same reasons discussed above. To reiterate, Mahnkopf, et al. fail to teach or suggest a *lightly doped region 18 directly underneath a base 14, where the lightly doped region fully depletes of mobile charge carriers through the first semiconducting layer to an isolating layer, as recited in Claim 1.*

Imai fails to fulfill the deficiencies of the primary reference, since Imai also fails to teach or suggest a *lightly doped region 18 directly underneath a base 14, where the lightly doped region fully depletes of mobile charge carriers through the first semiconducting layer to an isolating layer*. Referring to FIG. 4, Imai discloses a bipolar transistor including a quasi-neutral collector 14 directly underlying a p-intrinsic base 36. The bipolar transistor disclosed in Imai, similar to the bipolar transistor of Mahnkopf, et al., includes a collector region that is not fully depleted of high mobility charge carriers and results in a collector region having a high series resistance. Therefore, Imai fails to teach or suggest a *lightly doped region 18 directly underneath a base 14*, where the lightly doped region 18 fully depletes of mobile charge carriers through the first semiconducting layer to an isolating layer, as recited in Claim 1.

The §103 rejection also fails because there is no motivation in the applied references that suggests modifying the structures disclosed therein to include applicant's

claimed structure, which includes the features recited in Claim 1. The rejection is thus improper since the prior art does not suggest this drastic modification. The law requires that a prior art reference provide some teaching, suggestion, or motivation to make the modification obvious.

Here, there is no motivation provided in the disclosures of the applied prior art references, or otherwise of record, which would lead one skilled in the art to modify the structures of the applied references to include a *lightly doped region directly underneath, where the lightly doped region fully depletes of mobile charge carriers through the first semiconducting layer to an isolating layer.* "The mere fact that the prior art may be modified in the manner suggested by the Examiner does not make the modification obvious unless the prior art suggested the desirability of the modification." In re Fritch, 972 F.2d, 1260,1266, 23 USPQ 1780,1783-84 (Fed. Cir. 1992).

There is no suggestion in the prior art of applicant's structure, therefore all the claims of the present application are not obvious from the combined prior art references cited in the present Office Action.

Based on the above amendments and remarks, the §103 rejection citing Mahnkopf, et al. in combination with Imai has been obviated; therefore reconsideration and withdrawal of the instant rejections are respectfully requested.

Thus, in view of the foregoing amendments and remarks, it is firmly believed that the present case is in condition for allowance, which action is earnestly solicited.

Respectfully submitted,

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